CCR Number: 0012	CRITICALITY: URGENT	DUE:03/20/98

DISTRIBUTION SHEET
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Randy Harbaugh/Code 511

Dave Folta/Enhanced Formation Fly

John Loiacono/ALI Instrument Engr

Don Lencioni/EO-1 Instr. Scientist

NEW MILLENNIUM PROJECT CONFIGURATION CHANGE REQUEST

PROGRAM EO-1

CCR NO. 0012

DATE INITIATED 03/09/98

DUE DATE

TITLE B/L EO-1 SPACECRAFT LEVEL II REQUIREMENTS DOC.

ORIGINATOR R. CARTER/GSFC

ORIGINATOR'S CHG. NO.

SPONSOR/CODE R. CARTER PHONE x8421

EFFECTIVITY

ITEM: ~~BOTS DOC~~

S / N

ITEM:

S / N

ITEM:

S / N

CHANGE CLASS

	I	II
PRELIMINARY	☐	☐
FORMAL	☐	☐

TYPE OF CHANGE

MILESTONE	☐	INTERFACE	☒	SOFTWARE	☐
DOCUMENT	☒	POWER	☐	OTHER	☐
COST ____	☐	WEIGHT	☐	____	☐

DOCUMENTS OR SOFTWARE AFFECTED

EO-1 Level-II Spacecraft Segment Requirements

PROBLEM

The attached draft version of Earth Orbiter-1 (EO-1) Spacecraft Level II Requirements Document requires baselining. This document contains the New Millennium Program (NMP) EO-1 Spacecraft Level II Requirements. The Level II spacecraft requirements specify and define requirements at the spacecraft subsystem level functional and performance as well as interface requirements.
NOTE: Significant changes with regards to WIS, GIS and FODB are currently being considered. This CCR does not address these concerns, but will be addressed at a later date when the scope is better defined. The goal here is to baseline the requirements document and add changes via the CCR process at a later date.

PROPOSED SOLUTION

Approve the attached draft version of EO-1 Spacecraft Level II Requirements Document by the EO-1 Level II Configuration Control Board (CCB). Approval of this CCR will officially baseline this draft version of the Requirements document. Future changes will be initiated by submittal of Configuration Change Requests (CCRs) and Preliminary Specification Change Notices (PSCNs) for CCB approval. This document is maintained by the EO-1 Configuration Management Office (CMO).

BOARD ACTION		APPROVAL LEVEL REQUIRED		CRITICALITY LEVEL		PROCUREMENT CHANGE ORDER CLASSIFICATION					
APPROVE	☑	LEVEL I HQS	☐	EMERGENCY	☐	ROUTINE		URGENT		EMERGENCY	☐
APPROVE WITH CHANGE	☐	LEVEL II GSFC	☒	URGENT	☒	OPTION 1	☐	OPTION 1	☐		
DISAPPROVE	☐	LEVEL III	☐	ROUTINE	☐	OPTION 2	☐	OPTION 2	☐		
WITHDRAW	☐										

COMMENTS

CHAIRPERSON _____ DATE 28 JUL 98

3/28/96

New Millennium Program/Earth Orbiter-1 Spacecraft Level II Requirements

1.0 Introduction

This document contains the New Millennium Program (NMP)/Earth Orbiter-1 (EO-1) Spacecraft Level II Requirements. The Level II EO-1 spacecraft requirements specify and define requirements at the spacecraft subsystem levels. These requirements address spacecraft subsystem level functional and performance specifications as well as interface requirements.

The EO-1 mission requirement definition is accomplished in three levels. The Level I requirements define the EO-1 mission objectives and products. The Level II requirements identify and allocate appropriate requirements to mission segments (Technology, Spacecraft, Ground Segment). The Level II requirements are top level requirements for each mission segments. The Level III requirements are the lowest level requirements for the mission. The Level III requirements are directly implemented at the hardware and software levels. The Level III requirements are traced to Level II and then to Level I, respectively. All Level III requirements have either parent requirements in Level II and/or Level I, or have justification for its orphan status.

2.0 Requirement Organization

Requirements are organized and identified by Requirement ID, Requirement Type, Requirement Title, and Requirement Statement. The Requirement ID is a numbering system where each requirement is assigned a unique number. This number is used in tracing a requirement from parent to child and vice versa. The Requirement Type is an indicator for a type of requirement. The detailed description of the Requirement Type is provided in the section 3.0. The Requirement Title is a title for a requirement. The Requirement Statement provides the required action or activity. There is only one required action or activity per requirement statement.

3.0 Requirement Type Definition

H (Hierarchical) Requirement: A requirement which is not directly verifiable, but provide structure to a set of requirements. A Hierarchical requirement must be verified “through validation.” This means that the child requirements must be validated to define the success of the parent, and the child requirements must be verifiable. (Note: Child requirements may themselves be hierarchical.)

FC (Functional Category): A hierarchical requirement, which is the parent of a set of child requirements. Generally the functional category may be viewed as a container of a set of requirements which are “alike” in some manner such as; a. Similar Functionality
b. Same functionality applied to different elements
c. Are verified as a group.

F (Functional) Requirement: A functional requirement is a child requirement to a functional category. A functional requirement is the parent requirement to performance requirements. Functional requirements specify functions of the system, subsystem, instrument, or component. Functional requirements must be verifiable by test, analysis, or inspection.

P (Performance) Requirement: A performance requirement is a child requirement to a functional requirement. The performance requirements are directly verifiable, and each performance levels are verified. The performance requirements specify discrete performance levels of the system, subsystem, instrument, and/or component. The verification methods for performance requirements are test, analysis, and/or inspection.

4.0 Requirement Verification

The requirements shall be verified using methods accepted by the EO-1 Mission management. The acceptable verification methods include testing, analyses, and/or inspection. Positive verification for each requirement shall be provided. A requirement shall be verified either directly or indirectly. An example of an indirect verification would be such that Level I requirement is traced to Level II and then to Level III, where a direct verification of the Level III requirement is accomplished. In this case, the Level I and II requirements are verified indirectly and the Level III requirements are verified direcly. This is an acceptable verification approach.

5.0 Requirements Verification Matrix

The requirement verification matrix shall be developed. The matrix shall identify requirement, verification method, verification acceptable criteria, verification results, and the date of verification.

6.0 EO-1 System Validation

The requirement verification matrix, along with requirements tracing to either parent or child shall be the basis for the EO-1 system validation.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01	H	NMP/EO-1S/C Reqts:Lvl II	This document defines level II requirements for the New Millennium Program (NMP) EO-1 Spacecraft. The spacecraft shall provide all resources necessary to accommodate, operate, and validate the EO-1 technologies.
01.01	H	General	The Spacecraft shall adhere to the requirements in this section.
01.01.00.01	F	Mission Life	Shall be designed to support mission life of 1 year nominally and 18 months for expendables
01.01.00.01	F	Environment	All hardware and software shall adhere to EO-1 Environmental Requirements. Document, SAI-SPEC-158.
01.01.00.02	F	Contamination Control	The spacecraft and observatory materials, processes, and facilities shall exercise sufficient contamination control to facilitate validation of the technologies.
01.01.00.02.01	P	Radiation Environ-TID	All components used in the construction of the spacecraft shall be capable of performing to these requirements after being subjected to 15 Krads of Total Ionizing Dose on-orbit.
01.01.00.02.02	P	Radiation Environment -SEE	Parts used shall be immune to latchup. Parts which exhibit any Single Event Effects lower than 35 MEV shall not degrade mission performance.
01.01.00.03	F	Charging Prevention	The observatory design shall prevent surface charging/discharging effects capable of damaging observatory components.
01.01.00.04	F	Mission Assurance	All hardware and software shall adhere to EO-1 Mission Assurance Requirements.
01.01.00.05	F	Verification	Shall provide adequate visibility to accommodate effective subsystem and system functional and performance verification at all stages of development.
01.02	H	Attitude Control System (ACS)	The ACS shall provide three-axis stabilization.
01.02.01	FC	Orbit Determination and Knowledge	The spacecraft shall provide sufficient orbit determination to support the driving technology, with the requirements of the others falling within those limits.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.01.01	F	Ground Station Communication	Orbit determination shall provide sufficient knowledge to support communication with ground stations.
01.02.01.02	F	Image Gathering Planning	Orbit determination shall provide sufficient knowledge to plan, acquire (real-time), and post-process images with respect to the Earth and LandSat7.
01.02.01.02.01	P	Ground Track	Shall have sufficient precision to maintain +/- 3 Km (cross-track) of the Landsat 7 ground track.
01.02.01.02.02	P	Real-Time	Shall provide sufficient knowledge to perform to requirements of the WIS Spectral Purity pater. (Ref. Litton AM149-0042(155))
01.02.01.02.03	P	Post-Processing	Shall provide sufficient knowledge to perform to requirements of the WIS Spectral Purity Paper. (Ref. Litton AM149-0042(155))
01.02.01.02.04	P	Landsat 7 co-flying	
01.02.01.03	F	Ground-based Formation Flying	Shall provide sufficient knowledge to allow ground based formation flying with Landsat 7.
01.02.01.04	F	Enhanced Formation Flying	Shall be cabable of providing sufficient knowledge to perform enhanced formation flying.
01.02.02	FC	Orbit Control	Shall provide capability for orbit control.
01.02.02.01	F	Enhanced Formation Flying	Orbit control shall provide sufficient capability to perform enhanced formation flying.
01.02.02.02	F	Pointing Knowledge	Shall provide sufficient pointing knowledge for orbit maintenance.
01.02.02.03	F	Ground Track	Shall provide sufficient precision to maintain +/- 3 Km of the Landsat 7 ground
01.02.02.04	F	Equatorial Crossing	Nominal descending equatorial crossing time shall be 1 minute later than Landsat
01.02.02.05	F	Delta-V Maneuvers	Shall provide the capability for trajectory correction and orbit maintenance.
01.02.03	FC	Attitude Determination & Control	Attitude determination and control shall provide sufficient knowledge to support the mission.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.03.01	F	Technology Validation	Shall provide sufficient knowledge to support validation of the technologies. (WIS is most stringent)
01.02.03.02	F	Attitude Telemetry Validation	Telemetry shall be sufficient for ground verification and image processing.
01.02.03.03	F	WIS Validation	Shall provide sufficient control to validate the WIS.
01.02.03.03.01	P	90% Area Rule	Shall implement 90% area rule to 2 sigma. (Ref. Litton AM149-0042(155)).
01.02.03.04	F	Pointing Vector Offset	Shall allow for commanded offset of the pointing vector to allow for misalignment of the ALI boresight to the Nadir deck.
01.02.03.04.01	P	Offset amount	Offset shall be up to +/- 0.5 degrees in any axis.
01.02.03.05	F	Cross-Track	Shall allow for commanded cross-track pointing (about the roll axis).
01.02.03.05.01	P	Cross-track Pointing	Shall allow up to +/-6.5 degrees from nadir vector
01.02.03.05.01	P	Accuracy	Accuracy shall be TBD (derived from 90 % rule).
01.02.03.06	F	Solar Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.06.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.07	F	Lunar Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.07.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.08	F	Deep-Space Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.08.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.09	F	XPAA Pointing	Shall provide capability to point XPAA to a ground station autonomously.
01.02.03.09.01	P	Ground Station Pointing Accuracy	Pointing information shall be supplied to the XPAA to an accuracy of 1 degree during transmission only.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.03.09.02	P	Pointing Rate	Pointing command rate shall support a 2 Hz antenna beam position update rate.
01.02.03.10	F	Nadir Pointng	Shall be capable of maintaining a nadir pointing attitude indefinitely during normal operations.
01.02.03.11	F	Safe Pointing	Shall be capable of maintaining a power-positive and thermally-safe solar-pointing inertial hold attitude indefinitely.
01.02.03.12	F	Yaw Steering	Shall autonomously control yaw to meet the 90 % rule.
01.03	H	Power System	The Power System shall provide adequate power to S/C and technologies to perform required observations.
01.03.00.01	F	Total Power	Shall provide sufficient power to support the mission in all operational modes.
01.03.00.02	F	Energy Storage	Provide sufficient energy storage to support the mission.
01.03.00.03	F	Distribution	Provide power distribution within the EO-1 observatory.
01.03.00.04	F	Capacity	Power system shall have sufficient capacity to support all phases of the mission.
01.03.00.05	F	ALI Operation	The ALI Focal Place Electronics shall operate maximum of 10 minutes per daylight period of each orbit, not exceeding four times per 24 hour period.
01.03.00.06	F	Science Data Downlink (WARP Ops)	Shall provide sufficient capacity to support downlinking of a full WARP recorder twice per 24 hour period.
01.04	H	Electrical System	The electrical system shall provide services to all components per EO-1 Electrical Specifications. (ref. Litton AM-149-0020(155))
01.05	H	RF Communication System	The RF Communication System comprise both an X-Band and S-Band system to support all phases of the mission.
01.05.01	FC	S-Band Communications	S-Band communictions system shall provide command uplink, housekeeping telemetry and science telemetry in a contingency mode only.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.05.01.01	F	Antennae	Shall provide omni-directional coverage for S-band Communication.
01.05.01.01.01	P	Antenna Coverage	Shall Provide 80% spherical coverage
01.05.01.02	F	Ground Station Compatibility	Shall be capable of communication with Wallops Flight Facility - managed ground stations.
01.05.01.03	F	Uplink	S-Band command uplink shall be sufficient to validate technologies and operate spacecraft.
01.05.01.03.01	P	Uplink Rate	Uplink Rate shall be 2 Kbps
01.05.01.04	F	Housekeeping Downlink	S-Band shall be used for downlinkof housekeeping telemetry.
01.05.01.05	F	Science Telemetry	S-band shall be cabable of supporting up to 4 M bits per second for downlink of science telemetry in a contingency mode.
01.05.01.06	F	Coherent Communication / Ranging	The S-band shall be capable of performing ranging in coherent mode with a ground station in contingency mode (this requirement is verified by analysis and special test only)
01.05.01.07	F	Link Margin	Link margin shall be sufficient to support all phases of the mission.
01.05.01.07.01	P	Minimum Margin	3dB margin shall be maintained in all link budgets
01.05.01.08	F	Bit-Error-Rate (BER)	S-Band end-to-end BER shall be less than 10E-7.
01.05.02	FC	X-Band Communication	X-Band communications system shall provide downlink for science data.
01.05.02.01	F	Antenna	Shall accomodate Electronically-steerable Phased Array Antenna.
01.05.02.02	F	Ground Station	Shall transmit science data to a Wallops-managed Ground Station.
01.05.02.03	F	Frequency	Transmit frequency shall be per RF ICD.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.05.02.04	F	Transmission Rate	Rate shall be sufficient to empty WARP recorder during 1 telemetry pass of 10 minute duration.
01.05.02.04.01	P	Minimum Transmissi	Transmission rate shall be 105 Mbps.
01.05.02.05	F	Format	X-Band telemetry shall conform to CCSDS recommended standards.
01.05.02.06	F	Downlink Protocol	Downlink protocol shall use CCSDS 701 AOS.
01.05.02.07	F	Bit-Error-Rate (BER)	X-Band end-to-end BER shall be less than 10E-6.
01.06	H	Command and Data Handling (C&DH)	C&DH shall provide data processing, data storage, comand and control, telemetry and timing for the EO-1 Observatory.
01.06.01	FC	Command	C&DH shall process commands for execution aboard the observatory.
01.06.01.01	F	Commanding to Technologies	Shall provide sufficient commanding to support validation of the technologes.
01.06.01.02	F	Real-time Commands	Shall provide real-time command ingest and execution.
01.06.01.03	F	Stored Commands	Shall provide stored command capability.
01.06.01.04	F	Command Protocol	Shall conform to CCSDS COP-1 protocol.
01.06.02	FC	Telemetry	Shall be sufficient to support mission requirements.
01.06.02.01	F	Housekeeping (H/K) Data	Shall collect sufficient housekeeping data from all technologies and spacecraft for operations, health and safety assessment, and technology validation.
01.06.02.02	F	Science Data Back-up Path	Shall provide back-up science data path via S-Band.
01.06.02.03	F	Format	Shall conform to CCSDS AOS format.
01.06.03	FC	Wide Band Data Storage (WARP)	Shall provide adequate data storage for H/K and science data during mission.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.06.03.01	F	Science Data	Shall provide science data storage capacity to allow validation of the ALI and AC technologies.
01.06.03.01.01	P	Scene Storage	Shall be capable of storing two full scenes, each not exceeding 20 Gbits.
01.06.03.02	F	H/K Data during Scene taking	Shall be capable of storing H/K data during scene taking.
01.06.03.03	F	Data Ingest Rate	Shall provide sufficient ingest rate to capture all ALI, AC, and housekeeping data simultaneously.
01.06.03.03.01	P	Rate	TBD
01.06.03.04	F	Data Ingest path	WARP shall be capable of ingesting ALI and AC data from either FODB or RS422, selectable by command on-orbit.
01.06.03.05	F	Data Playback	WARP shall be capable of playback of science and housekeeping telemetry at 105 Mbps.
01.06.03.06	F	Back-up Playback	Shall have back-up playabck capability at 4 Mbps (S-band).
01.06.04	FC	H/K Data Storage	Shall have sufficient H/K data storage capacity.
01.06.04.01	F	H/K Data Overflow	Overflow of H/K data shall be prohibited between nominal ground contacts
01.06.04.01	P	Storage Capacity	Shall be capable of storing housekeeping data for 24 hours without overflow
01.06.05	FC	Timing	Shall maintain and distribute time to sufficient accuracy to support the mission.
01.06.05.01	F	Technologies	Shall provide sufficient timekeeping to support technologies.
01.06.05.01.01	P	ALICE	Shall provide 10 msec accuracy to ALICE, with respect to UTC.
01.06.05.02	F	ACS	Shall provide sufficient timekeeping to support attitude determination and control.
01.06.05.03	F	Relative Accuracy	Observatory time shall be maintained to the required accuracy.
01.06.05.03.01	P	On-board Accuracy	Time shall be maintained to within 1 mS between observatory components.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.06.05.04	F	Ground Time Correlation	Observatory time shall be correlated to ground time with required accuracy.
01.07	H	Propellant	Shall provide enough propellant to support the mission.
01.07.00.01	F	Fuel for Formation Flying	Fuel shall be sufficent to support Formation Flying with Landsat 7.
01.07.00.02	F	Fuel for Mission Ops & Disposal	Sufficient fuel shall remain at the end of the nominal mission plus extended operations to de-orbit within the timeframe dictated in NMI 1740.A.
01.08	H	Structure	The structure shall be sufficient to support validation of the technologies.
01.08.01	FC	Alignment	Shall determine alignment and make measurements.
01.08.01.01	F	Alignment Placement	Shall determine and maintain on-orbit alignment between instruments and ACS components during all phases of the mission.
01.08.01.02	F	Alignment Measurement	Shall make alignment measurements.
01.08.01.03	F	ALI and AC	ALI and AC shall be co-aligned.
01.08.01.03.01	P	Alignment Accuracy	ALI and AC instrument shall be mounted to within 0.25 degrees as listed in ICD.
01.08.01.03.02	P	Measurement Accuracy	ALI and AC placement shall be measured to 30 Arcsec with respect to the ACS Reference.
01.08.01.04	F	Jitter Limiting	The design of the structure shall limit the jitter.
01.08.01.04.01	P	Jitter Budget	Shall be within the jitter allocation of the WIS 90% area rule error budget
01.08.02	FC	Technology Mounting	Technology mounting on S/C shall allow technology validation.
01.08.02.01	F	LFSA Mounting	Shall provide mounting surface to allow deployment and sufficient view of the sun to support validation.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.08.02.02	F	CCR Mounting	Shall mount sufficient heat source in the vicinity of the CCR to allow heat conductivity validation.
01.08.02.03	F	PPT Mounting	Shall be mounted to allow pitch axis control.
01.09	H	Launch Vehicle	Shall be designed to accomodate launch vehicle.
01.09.00.01	F	Launch Vehicle Constraint	Shall be designed to launch as a top payload on the dual payload attach fitting on the Delta 7320 with 10 foot fairing.

Date: Mon, 23 Mar 1998 12:20:35 -0500 (Eastern Standard Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Mark Perry/Swales)
Subject: CCR:0012 - DUE: 03/20/98   URGEN Level-2 Mark Perry/Swale WWW-COMMENTS

USER :   (Mark Perry/Swales) sent the following comments on :

Date: 03/23/1998
CCR Number: 0012
Sponsor: R. CARTER
Due Date: 03/20/98

CCR Title: B/L EO-1 SPACECRAFT LEVEL II REQUIREMENTS DOC.

Remote host: 198.118.115.46 Email Address:

APPROVAL STATUS: APPROVED
Note:

COMMENTS:

Cont. control. Please clean it up & make it reference correctly

0012

NMP EO-1 Level II Spacecraft Requirements

SPI failure comments

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01	H	NMP/EO-1 S/C Reqts:Lvl II	This document defines level II requirements for the New Millennium Program (NMP) EO-1 Spacecraft. The spacecraft shall provide all resources necessary to accommodate, operate, and validate the EO-1 technologies.
01.01	H	General	The Spacecraft shall adhere to the requirements in this section.
01.01.00.01	F	Mission Life	Shall be designed to support mission life of 1 year nominally and 18 months for expendables
01.01.00.01	F	Environment	All hardware and software shall adhere to EO-1 Environmental Requirements. Document, SAI-SPEC-158.
01.01.00.02	F	Contamination Control	The spacecraft and observatory materials, processes, and facilities shall exercise sufficient contamination control to facilitate validation of the technologies.
01.01.00.02.01	P	Radiation Environ-TID	All components used in the construction of the spacecraft shall be capable of performing to these requirements after being subjected to 15 Krads of Total Ionizing Dose on-orbit.
01.01.00.02.02	P	Radiation Environment -SEE	Parts used shall be immune to latchup. Parts which exhibit any Single Event Effects lower than 35 MEV shall not degrade mission performance.
01.01.00.03	F	Charging Prevention	The observatory design shall prevent surface charging/discharging effects capable of damaging observatory components.
01.01.00.04	F	Mission Assurance	All hardware and software shall adhere to EO-1 Mission Assurance Requirements
01.01.00.05	F	Verification	Shall provide adequate visibility to accommodate effective subsystem and system functional and performance verification at all stages of development.
01.02	H	Attitude Control System (ACS)	The ACS shall provide three-axis stabilization.
01.02.01	FC	Orbit Determination and Knowledge	The spacecraft shall provide sufficient orbit determination to support the driving technology, with the requirements of the others falling within those limits.

These are radiation effects, but the Paragraph #'s seem to indicate that they apply to

Does the Environmental Req. Doc. cover S/W? If not, please put the appropriate doc in here.

OK, but I'm not sure how this can be verified. Leave IF no one else objects.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.01 .01	F	Ground Station Communication	Orbit determination shall provide sufficient knowledge to support communication with ground stations.
01.02.01.02	F	Image ~~Gathering~~ ~~Planning~~ taking	Orbit determination shall provide sufficient knowledge to @&acquire (real-time), and post-process images with respect to the Earth and LandSat7.
01.02.01.02.01	P	Ground Track	Shall have sufficient precision to maintain +/- 3 Km (cross-track) of the Landsat 7 ground track.
01.02.01.02.02	P	Real-Time	Shall provide sufficient knowledge to perform to requirements of the WIS Spectral Purity pater. (Ref. Litton AM1 49-0042(155))
01.02.01.02.03	P	Post-Processing	Shall provide sufficient knowledge to perform to requirements of the WIS Spectral Purity Paper. (Ref. Litton AM149-0042(155))
01.02.01.02.04	P	Landsat 7 co-flying	
01.02.01.03	F	Ground-based Formation Flying	Shall provide sufficient knowledge to allow ground based formation flying with Landsat 7.
01.02.01.04	F	Enhanced Formation Flying	Shall be cabable of providing sufficient knowledge to perform enhanced formation flying.
01.02.02	FC	Orbit Control	Shall provide capability for orbit control.
01.02.02.01	F	Enhanced Formation Flvina	Orbit control shall provide sufficient capability to ~~perform~~ support enhanced formation flvina.
01.02.02.02	F	Pointing Knowledge	Shall provide sufficient pointing knowledge for orbit maintenance.
01.02.02.03	F	Ground Track	Shall provide sufficient precision to maintain +/- 3 Km of the Landsat 7 ground ~~track~~
01.02.02.04	F	Equatorial Crossing	Nominal descending equatorial crossing time shall be 1 minute later than Landsat
01.02.02.05	F	Delta-V Maneuvers	Shall provide the capability for trajectory correction and orbit maintenance.
01.02.03	FC	Attitude Determination & Control	Attitude determination and control shall provide sufficient knowledge to support the mission.

I'm not sure what part of on-board orbit determination is used in Planning. By That I mean planning as done on The GND.

even after we put out The next CCR to remove WIS leave This here ~~here~~ or at lease point to The ref. Doc.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.03.01	F	Technology Validation	Shall provide sufficient knowledge to support validation of the technologies. (WIS is most stringent)
01.02.03.02	F	Attitude Telemetry Validation	Telemetry shall be sufficient for ground verification and image processing.
01.02.03.03	F	WIS Validation	Shall provide sufficient control to validate the WIS.
01.02.03.03.01	P	90% Area Rule	Shall implement 90% area rule to 2 sigma. (Ref. Litton AM149-0042(155)).
01.02.03.04	F	Pointing Vector Offset	Shall allow for commanded offset of the pointing vector to allow for misalignment of the ALI boresight to the Nadir deck.
01.02.03.04.01	P	Offset amount	Offset shall be up to +/- 0.5 degrees in any axis.
01.02.03.05	F	Cross-Track	Shall allow for commanded cross-track pointing (about the roll axis).
01.02.03.05.01	P	Cross-track Pointing	Shall allow up to +/-6.5 degrees from nadir vector
01.02.03.05.01	P	Accuracy	Accuracy shall be TBD (derived from 90 % rule).
01.02.03.06	F	Solar Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.06.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.07	F	Lunar Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.07.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.08	F	Deep-Space Calibration	Shall provide capability to perform slew-and-hold or slew-and-scan calibration scenario.
01.02.03.08.01	P	Accuracy	Accuracy shall be within 0.25 degrees, 3 sigma, per axis.
01.02.03.09	F	XPAA Pointing	Shall provide capability to point XPAA to a ground station autonomously.
01.02.03.09.01	P	Ground Station Pointing Accuracy	Pointing information shall be supplied to the XPAA to an accuracy of 1 degree during transmission only.

I believe This # exists in The Litton document

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.02.03.09.02	P	Pointing Rate	Pointing command rate shall support a 2 Hz antenna beam position update rate.
01.02.03.10	F	Nadir Pointng	Shall be capable of maintaining a nadir pointing attitude indefinitely during normal operations.
01.02.03.11	F	Safe Pointing	Shall be capable of maintaining a power-positive and thermally-safe solar-pointing inertial hold attitude indefinitely.
~~01.02.03.12~~	~~F~~	~~Yaw Steering~~	~~Shall autonomously control yaw to meet the 90 % rule.~~
01.03	H	Power System	The Power System shall provide adequate power to S/C and technologies to perform required observations.
01.03.00.01	F	Total Power	Shall provide sufficient power to support the mission in all operational modes.
01.03.00.02	F	Energy Storage	Provide sufficient energy storage to support the mission.
01.03.00.03	F	Distribution	Provide power distribution within the EO-1 observatory.
01.03.00.04	F	Capacity	Power system shall have sufficient capacity to support all phases of the mission.
01.03.00.05	F	ALI Operation	The ALI Focal Place Electronics shall operate maximum of 10 minutes per daylight period of each orbit, not exceeding four times per 24 hour period.
01.03.00.06	F	Science Data Downlink (WARP Ops)	Shall provide sufficient capacity to support downlinking of a full WARP recorder twice per 24 hour period.
01.04	H	Electrical System	The electrical system shall provide services to all components per EO-1 Electrical Specifications. (ref. Litton AM-149-0020(155))
01.05	H	RF Communication System	The RF Communication System comprise both an X-Band and S-Band system to support all phases of the mission.
01.05.01	FC	S-Band Communications	S-Band communictions system shall provide command uplink, housekeeping telemetry and science telemetry in a contingency mode only.

This is a subset of 01.02.03.03.01 and is ∴ redundant

and tracking (two way doppler and angle)

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.05.01 .01	F	Antennae	Shall provide omni-directional coverage for S-band Communication.
01.05.01 .01.01	P	Antenna Coverage	Shall Provide 80% spherical coverage
01.05.01.02	F	Ground Station Compatibility	Shall be capable of communication with Wallops Flight Facility - managed ground stations.
01.05.01.03	F	Uplink	S-Band command uplink shall be sufficient to validate technologies and operate spacecraft.
01.05.01.03.01	P	Uplink Rate	Uplink Rate shall be 2 Kbps
01.05.01.04	F	Housekeeping Downlink	S-Band shall be used for downlinkof housekeeping telemetry.
01.05.01.05	F	Science Telemetry	S-band shall be cabable of supporting up to ~~4~~ M bits per second for downlink of science telemetry in a contingency mode. 1 only 1 Mbps required
01.05.01.06	F	Coherent Communication / Ranging	The S-band shall be capable of performing ranging in coherent mode with a ground station in contingency mode (this requirement is verified by analysis and special test only)
01.05.01.07	F	Link Margin	Link margin shall be sufficient to support all phases of the mission.
01.05.01.07.01	P	Minimum Margin	3dB margin shall be maintained in all link budgets
01.05.01.08	F	Bit-Error-Rate (BER)	S-Band end-to-end BER shall be less than 10E-7.
01.05.02	FC	X-Band Communication	X-Band communications system shall provide downlink for science data.
01.05.02.01	F	Antenna	Shall accomodate Electronically-steerable Phased Array Antenna.
01.05.02.02	F	Ground Station	Shall transmit science data to a Wallops-managed Ground Station.
01.05.02.03	F	Frequency	Transmit frequency shall be per RF ICD.

Downlink rate of 32 kbps max for TLM performance requirement.

Dan has The [redacted] Specific name of This ICD.

Rlequirement ID	Reqt Type	Requirement Title	Requirement Statement
01l.06.03.01	F	Science Data	Shall provide science data storage capacity to allow validation of the ALI and AC technologies.
0'1.06.03.01.O 1	P	Scene Storage	Shall be capable of storing two full scenes, each not exceeding 20 Gbits.
0'l.06.03.02	F	H/K Data during Scene takina	Shall be capable of storing H/K data during scene taking.
0'l.06.03.03	F	Data Ingest Rate	Shall provide sufficient ingest rate to capture all ALI, AC, and housekeeping data simultaneously.
0'1.06.03.03.0 1	P	Rate	TBD
0'l.06.03.04	F	Data Ingest path	WARP shall be capable of ingesting ALI and AC data from either FODB or RS422, selectable by command on-orbit.
0'l.06.03.05	F	Data Playback	WARP shall be capable of playback of science and housekeeping telemetry at 105 Mbps. into The X-band Phased Array.
0'1.06.03.06	F	Back-up Playback	Shall have back-up playabck capability at 4 Mbps (S-band).
0'1.06.04	FC	H/K Data Storage	Shall have sufficient H/K data storage capacity.
0'1.06.04.01	F	H/K Data Overflow	Overflow of H/K data shall be prohibited between nominal ground contacts
0'1.06.04.01	P	Storage Capacity	Shall be capable of storing housekeeping data for 24 hours without overflow
01.06.05	FC	Timing	Shall maintain and distribute time to sufficient accuracy to support the mission.
0'1.06.05.01	F	Technologies	Shall provide sufficient timekeeping to support technologies.
0'1.06.05.01.0 1	P	ALICE	Shall provide 10 msec accuracy to ALICE, with respect to UTC.
01.06.05.02	F	ACS	Shall provide sufficient timekeeping to support attitude determination and control.
01.06.05.03	F	Relative Accuracy	Observatory time shall be maintained to the required accuracy.
01.06.05.03.0 1	P	On-board Accuracy	Time shall be maintained to within 1 mS between observatory components.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.06.05.04	F	Ground Time Correlation	Observatory time shall be correlated to ground time with required accuracy.
01.07	H	Propellant	Shall provide enough propellant to support the mission.
01.07.00.01	F	Fuel for Formation Flying	Fuel shall be sufficent to support Formation Flying with Landsat 7.
01.07.00.02	F	Fuel for Mission Ops & Disposal	Sufficient fuel shall remain at the end of the nominal mission plus extended operations to de-orbit within ~~the timeframe dictated~~ 25 yrs as in NMI 1740.A.
01.08	H	Structure	The structure shall be sufficient to support validation of the technologies.
01.08.01	FC	Alignment	Shall determine alignment and make measurements.
01.08.01 .01	F	Alignment Placement	Shall determine and maintain on-orbit alignment between instruments and ACS components during all phases of the mission.
01.08.01.02	F	Alignment Measurement	Shall make alignment measurements.
01.08.01.03	F	ALI and AC	ALI and AC shall be co-aligned.
01.08.01.03.01	P	Alignment Accuracy	ALI and AC instrument shall be mounted to within 0.25 degrees as listed in ICD.
01.08.01.03.02	P	Measurement Accuracy	ALI and AC placement shall be measured to 30 Arcsec with respect to the ACS Reference.
01.08.01.04	F	Jitter Limiting	The design of the structure shall limit the jitter.
01.08.01.04.01	P	Jitter Budget	Shall be within the jitter allocation of the WIS 90% area rule error budget
01.08.02	FC	Technology Mounting	Technology mounting on S/C shall allow technology validation.
01.08.02.01	F	LFSA Mounting	Shall provide mounting surface to allow deployment and sufficient view of the sun to support validation.

S/C to ALI ICD and SK to AC ICD I presume. Check w/ Matt.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.05.02.04	F	Transmission Rate	Rate shall be sufficient to empty WARP recorder during 1 telemetry pass of 10 minute duration.
01.05.02.04.01	P	Minimum Transmissi	Transmission rate shall be 105 Mbps.
01.05.02.05	F	Format	X-Band telemetry shall conform to CCSDS recommended standards.
01.05.02.06	F	Downlink Protocol	Downlink protocol shall use CCSDS 701 AOS.
01.05.02.07	F	Bit-Error-Rate (BER)	X-Band end-to-end BER shall be less than 10E-6.
01.06	H	Command and Data Handling (C&DH)	C&DH shall provide data processing, data storage, comand and control, telemetry and timing for the EO-1 Observatory.
01.06.01	FC	Command	C&DH shall process commands for execution aboard the observatory.
01.06.01 .Ol	F	Commanding to Technologies	Shall provide sufficient commanding to support validation of the technologes.
01.06.01.02	F	Real-time Commands	Shall provide real-time command ingest and execution.
01.06.01.03	F	Stored Commands	Shall provide stored command capability.
01.06.01.04	F	Command Protocol	Shall conform to CCSDS COP-I protocol.
01.06.02	FC	Telemetry	Shall be sufficient to support mission requirements.
01.06.02.01	F	Housekeeping (H/K) Data	Shall collect sufficient housekeeping data from all technologies and spacecraft for operations, health and safety assessment, and technoloav validation.
01.06.02.02	F	Science Data Back-up Path	Shall provide back-up science data path via S-Band.
01.06.02.03	F	/Format	Shall conform to CCSDS AOS format.
01.06.03	FC	Wide Band Data Storage (WARP)	Shall provide adequate data storage for H/K and science data during mission.

Requirement ID	Reqt Type	Requirement Title	Requirement Statement
01.08.02.02	F	CCR Mounting	Shall mount sufficient heat source in the vicinity of the CCR to allow heat conductivity validation.
01.08.02.03	F	PPT Mounting	Shall be mounted to allow pitch axis control.
01.09	H	Launch Vehicle	Shall be designed to accomodate launch vehicle.
01.09.00.01	F	Launch Vehicle Constraint	Shall be designed to launch as a top payload on the dual payload attach fitting on the Delta 7320 with 10 foot fairing.

We need a tiny section on Thermal control saying we need to provide Thermal control adequate to protect The Technologies per Their ICDs.

Thermal

Date: Mon, 04 May 1998 09:45:37 -0400 (Eastern Daylight Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Brian Smith)
Subject: CCR:0012 - DUE: 03/20/98   URGEN Level-2 Brian Smit WWW-COMMENTS

USER :   (Brian Smith) sent the following comments on :

Date: 05/04/98
CCR Number: 0012
Sponsor: R. CARTER
Due Date: 03/20/98

CCR Title: B/L EO-1 SPACECRAFT LEVEL II REQUIREMENTS DOC.

Remote host: 198.118.115.72 Email Address:

APPROVAL STATUS: APPROVED WITH COMMENTS
Note:

COMMENTS: CCR12 approved as is, if no other comments are incorporated. This will baseline the document. This is important since this is the version to which the Spacecraft Contractor is held responsible. If changes are proposed, they must be offered through a second CCR.

CCR SPONSOR RECOMMENDATION FORM

CCR NUMBER: 0012

CCR TITLE: B/L EO-1 SPACECRAFT LEVEL II REQUIREMENTS

CCR SPONSOR: Ruth Carter/GSFC

SUMMARY OF COMMENTS RECEIVED: (list Level 4 CCB and internal reviewers who had comments and address those comments)

Pete Spidaliere: See hard copy red lines.

Brian Smith: CCR 0012 approved as is, if no other comments are incorporated. This will baseline the document. This is important since this is the version to which the Spacecraft Contractor is held responsible. If changes are proposed, they must be offered through a second CCR.

Sponsor Comment: Agree.

Sponsor Recommendation: Incorporate all of the recommended changes to document which includes the attached red lines.

SPONSOR/ORGANIZATION: Ruth Carter/GSFC

DATE: 5/14/98